

PRELIMINARY DATA SUMMARY

April 1985

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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## I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table I is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table I. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. H. Carl Miller at (919) 261-3511.

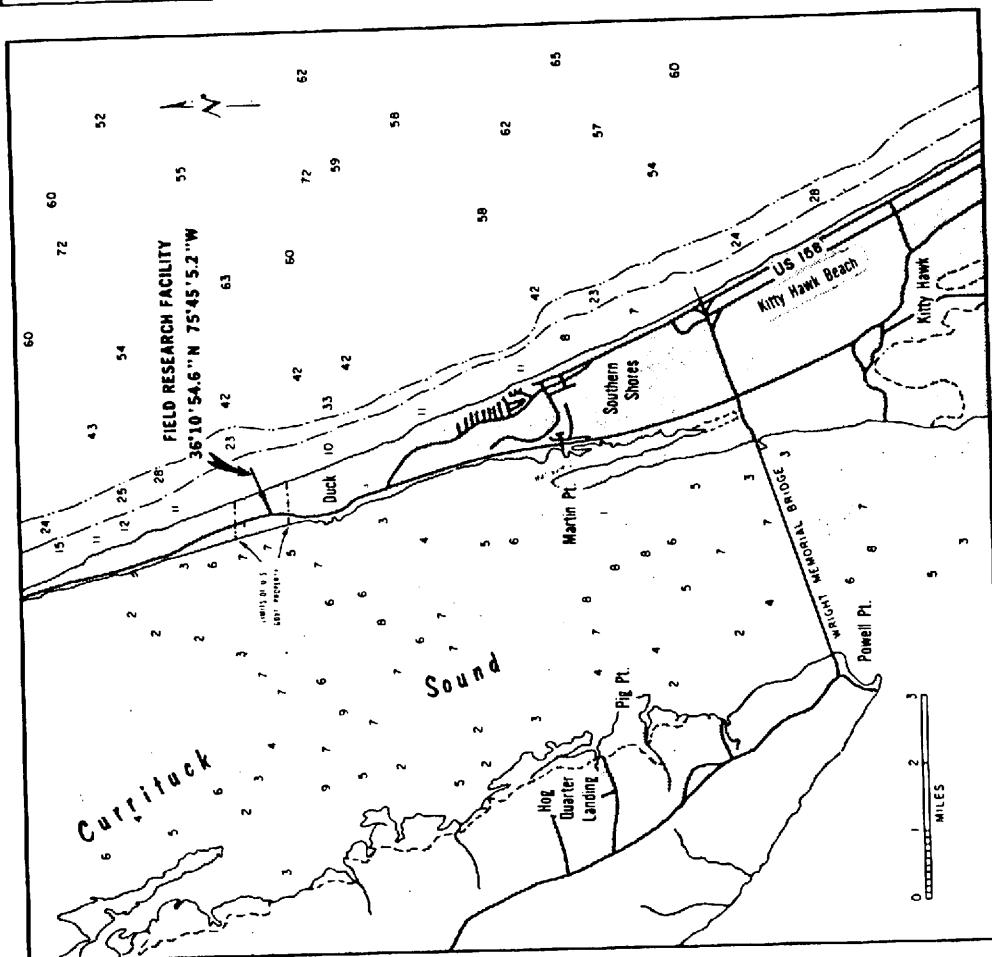
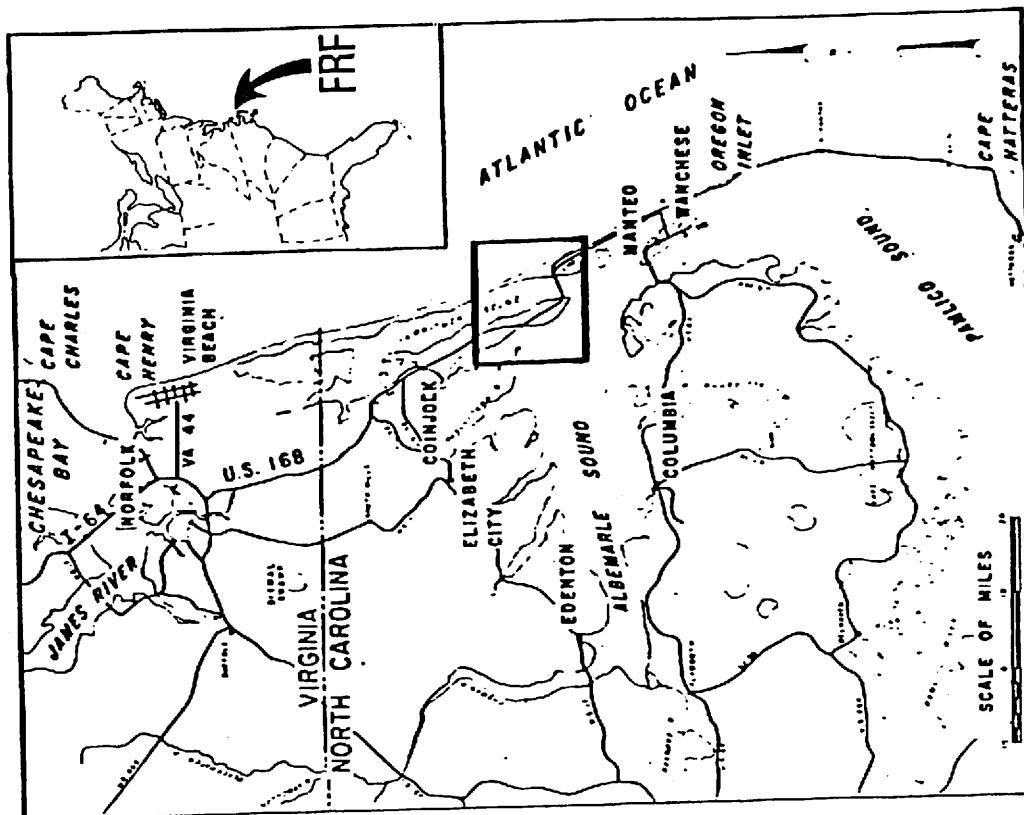
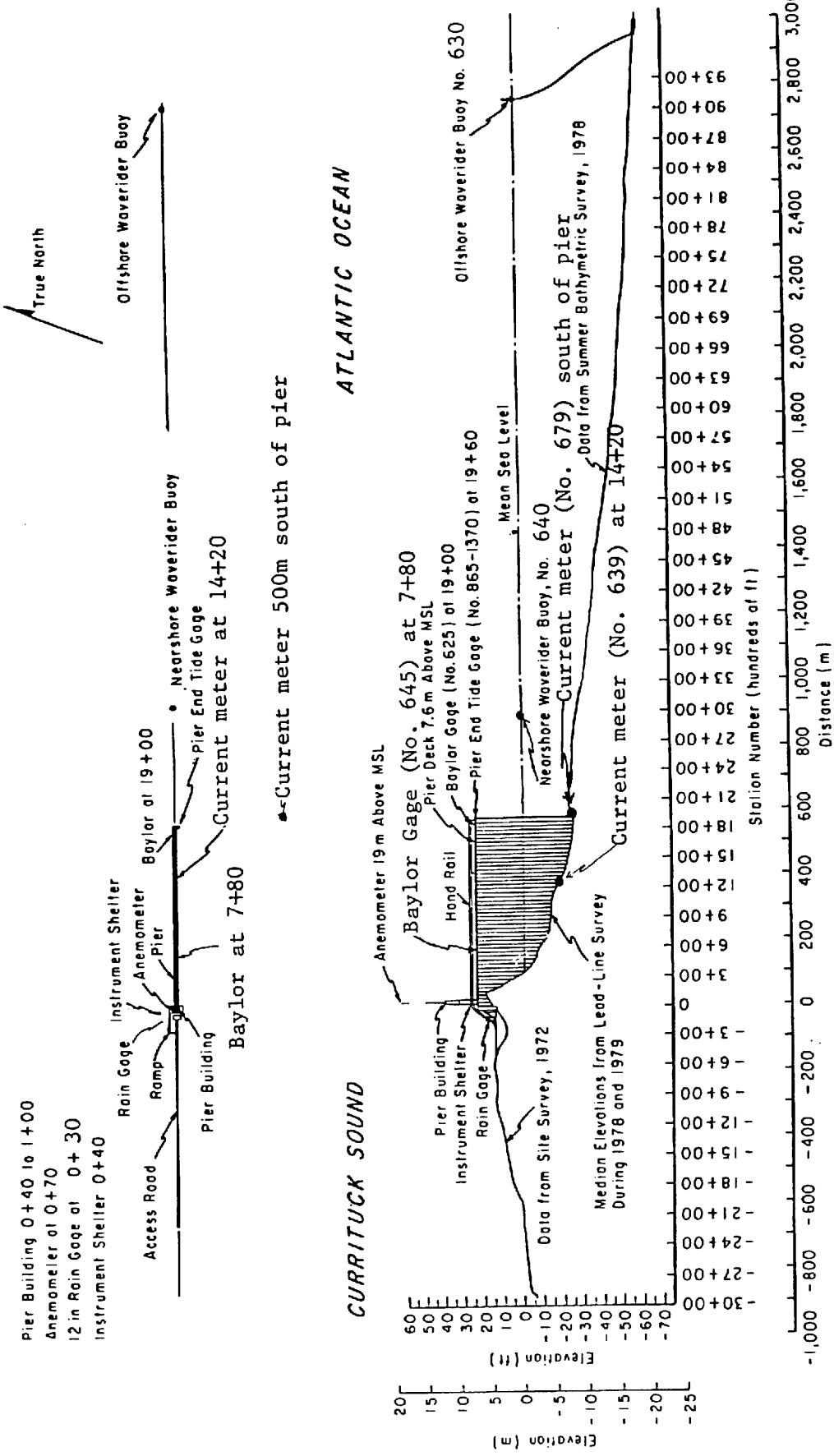


Figure 1. FRF Location Map

TABLE I  
INSTRUMENT STATUS/DATA AVAILABILITY

CAGE NUMBER	DESCRIPTION/REMARKS	DEPTH AT SENSOR	DAY OF THE MONTH											
			1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30/											
	Barometric Pressure		Data Collected											
			Analog Record											
			Instrument Status											
	Precipitation		Data Collected											
			Analog Record											
			Instrument Status											
	Air Temperature		Date Collected											
			Maximum/Minimum											
	Anemometer on Lab Bldg - Elevation 19m (HSL)		Instrument Status											
			Data Collected											
			Analog Record											
	Baylor staff located at station 7+80 on FRP pier	See profile data	Instrument Status											
645			Data Collected											
	Baylor staff located at station 19+00 on FRP pier	Sea profile data	Instrument Status											
625			Data Collected											
	Waverider buoy located 1.0 km from shore	Approx. 6.5 m. HSL	Instrument Status											
640			Data Collected											
	Waverider buoy located 6.0m from shore	Approx. 18 m. HSL	Instrument Status											
630			Data Collected											
	Current meter at station 14+20 on FRP pier	See profile data	Instrument Status											
639			Data Collected											
	Current meter 500m south (0.5km offshore)	Approx. 6 m. HSL	Instrument Status											
679			Data Collected											
	HOLA primary tide station located at seaward end of RAY pier	Instrument Status												
665-1170			Data Collected											

Instrument Status: Operational  - Daily Observation: YES   
Data Collected: ALL  , SOME Analog Record: ALL  , PARTIAL   
Preliminary Analysis: ALL  , SOME



## II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Data General NOVA-4 computer. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -  
 $mm \times .03937 = in$

2. Millibars (mb) to inches of mercury (in Hg) -  
 $mb \times 0.02953 = in Hg$

3. Degrees Celcius ( $^{\circ}C$ ) to degrees Fahrenheit ( $^{\circ}F$ ) -  
 $(^{\circ}C \times 9/5) + 32 = ^{\circ}F$

4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

TABLE 2: METEOROLOGICAL DATA

PART 1

APRIL 1925

DAY	HOUR	WIND SPEED (M/S)	WIND DIRECTION (DEG TN)	TEMPERATURE (DEG C)	ATM PRESSURE (Hg)	PRECIPITATION (MM)
1	100	5	223	13.2	1005.3	0
	700	7	250	14.7	1007.7	0
	1300	7	271	20.4	1005.6	0
	1900	5	295	19.2	1004.6	0
2	100	10	31	9.5	1011.3	0
	700	6	60	8.7	1010.7	0
	1300	7	135	11.0	1008.4	0
	1900	5	135	9.6	1009.7	0
3	100	6	355	9.0	1011.9	0
	700	4	119	9.2	1011.9	0
	1300	8	230	17.0	1007.9	0
	1900	9	212	15.4	1005.4	0
4	100	7	253	14.0	1003.5	0
	700	1	67	13.2	1014.3	0
	1300	3	123	15.1	1015.7	0
	1900	5	205	17.4	1012.5	0
5	100	7	231	17.1	1013.2	0
	700	8	229	17.9	1014.6	0
	1300	6	203	24.5	1013.4	0
	1900	10	219	19.6	1011.5	0
6	100	9	211	19.0	1007.2	0
	700	10	214	19.7	1007.5	0
	1300	13	265	21.5	1003.1	0
	1900	7	265	19.6	1011.5	0
7	100	3	287	15.6	1015.4	0
	700	3	124	11.6	1023.5	0
	1300	6	143	13.7	1017.1	0
	1900	10	232	18.4	1012.0	0
8	100	6	297	9.7	1013.2	0
	700	5	303	9.5	1013.8	0
	1300	7	280	13.9	1017.2	0
	1900	6	315	11.5	1013.2	0
9	100	2	102	5.2	1017.3	0
	700	7	230	8.2	1017.5	0
	1300	11	303	9.3	1013.5	0
	1900	9	13	6.2	1021.5	0
10	100	6	345	3.1	1025.9	0
	700	7	339	2.6	1029.2	0
	1300	3	8?	6.6	1029.2	0
	1900					0
11	100			Software crash		
	700			9.9	1027.3	0
	1300	6	262	17.1	1024.9	0
	1900	5	197	15.0	1024.3	0
12	100	3	249	12.3	1026.3	0
	700	2	251	12.9	1023.4	0
	1300	2	73	14.9	1029.9	0
	1900	2	114	11.5	1029.4	0
13	100	2	10+	10.9	1029.3	0
	700	3	14?	12.7	1028.7	0
	1300			Software crash		
	1900	3	103	13.7	1025.0	0
14	100	0		13.5	1024.4	0
	700	5	73	13.1	1023.0	0
	1300	6	79	13.9	1019.9	0
	1900	5	68	13.3	1016.6	0
15	100	12	53	13.6	1012.0	0
	700	9	64	12.7	1027.9	0
	1300	6	3	14.0	1003.2	0
	1900	2	302	15.6	1009.9	0
16	100	1	5	14.1	1010.1	0
	700	0		13.1	1010.2	0
	1300	2	95	16.4	1010.6	0
	1900	4	152	13.5	1009.5	0

TABLE 2: METEOROLOGICAL DATA

PART 2

APRIL 1935

		WIND SPEED DAY HOUR	AIR DIRECTION (DEG TN)	TEMPERATURE (DEG C)	ATM. PRESSURE (MB)	PRECIPITATION (MM)
17	100	4	323	16.3	1010.6	0
	700	14	41	12.2	1019.1	0
	1300	11	32	11.3	1022.3	0
	1900	4	67	9.4	1023.3	0
18	100	2	73	9.8	1024.3	0
	700	1	22	12.7	1025.0	0
	1300	6	165	17.3	1023.6	0
	1900	6	210	17.4	1020.9	0
19	100	8	241	15.1	1020.7	0
	700	9	251	16.8	1019.3	0
	1300	6	255	26.0	1013.2	0
	1900	4	211	22.9	1015.0	0
20	100	5	246	19.2	1016.7	0
	700	6	259	18.6	1017.6	0
	1300	1	92	27.1	1017.9	0
	1900	4	155	13.6	1017.2	0
21	100	3	243	19.3	1019.0	0
	700	1	244	19.4	1013.3	0
	1300	2	93	22.4	1015.3	0
	1900	5	120	19.2	1017.2	0
22	100	2	241	19.5	1017.1	0
	700	3	305	21.7	1017.9	0
	1300	3	287	32.3	1016.5	0
	1900	3	203	24.4	1014.5	0
23	100	6	250	21.0	1014.3	0
	700	4	277	21.9	1015.3	0
	1300	2	120	26.4	1015.0	0
	1900	3	77	17.7	1014.0	0
24	100	7	117	18.0	1013.3	0
	700	7	119	18.6	1014.7	0
	1300	10	151	21.8	1014.0	0
	1900	4	151	17.2	1011.7	0
25	100	6	225	20.2	1009.3	0
	700	7	274	20.2	1009.1	0
	1300	3	53	19.0	1007.2	0
	1900	2	161	17.9	1009.5	0
26	100	3	345	15.8	1011.5	0
	700	5	341	18.6	1014.6	0
	1300	3	112	20.9	1014.4	0
	1900	4	201	21.0	1013.7	0
27	100	8	241	19.6	1013.9	0
	700	9	253	19.9	1013.0	0
	1300	3	259	27.9	1012.4	0
	1900	2	212	23.4	1011.7	0
28	100	6	117	17.3	1012.2	0
	700	2	242	20.5	1012.9	0
	1300	3	90	21.6	1010.5	0
	1900	5	30	16.7	1010.2	0
29	100	11	47	16.3	1012.3	0
	700	13	35	12.8	1014.9	0
	1300	10	35	13.3	1013.7	0
	1900	5	64	12.0	1013.7	0
30	100	2	14	12.1	1023.5	0
	700	3	347	14.3	1023.2	0
	1300	2	93	19.3	1021.3	0
	1900	5	155	15.0	1019.3	0

### III. WAVE DATA

Wave data were collected from two Baylor staff gages (CERC gage Nos. 625 and 645) and Waverider buoys (CERC gage Nos. 630 and 640, Table 1 and Figure 2). The data were collected, analyzed, and stored on magnetic tape using a Data General NOVA-4 computer.

The NOVA-4 is programmed to sample the wave gages every 6 hours near 0100, 0700, 1300, and 1900 EST at a sampling rate of four times per second, collecting data in 20-minute records.

Wave height ( $H_{mo}$ ) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. The wave period is identified from the computation of a variance (energy) spectrum using a Fast Fourier Transform of 4096 data points (1024 sec). The period ( $T_p$ ) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape and entered into the CERC data base.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means shown in Table 3 are an average of the values computed for all data records collected. The monthly standard deviations are standard deviations from the monthly mean of values for each record.

Figure 3 is a time history of the  $H_{mo}$  and  $T_p$  values for the Waverider 6 km from shore (630) and the Baylor gage at pier station 19+00 (625).

Differences in wave periods between wave gages (Table 4 and Figure 3) may be due to wave breaking or reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

PART 1										
APRIL 1985										
GAGE	DAY	TIME	645		625		640		630	
			Baylor	at 7+80	Baylor	at 19+00	Nearsho	Wvrdr	Farshr	Wvrdr
			Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)	Hmo(m)	T(sec)
	1	.51	5.99		.82	8.83	.82	8.83	1.14	5.99
	7	.49	5.99		.68	7.42	.68	8.83	.98	7.42
	13	.48	6.87		.60	16.79	.70	6.40	.77	7.42
	19	.53	7.42		.60	16.79	.64	16.79	.65	7.42
2	1	.81	3.51		.95	3.51	.94	3.38	.93	3.51
	7	.76	5.63	1.15	5.63		1.14	6.40	1.38	5.63
	13	.61	14.22	.96	14.22		.94	14.22	1.01	14.22
	19	.50	7.42	.80	14.22		.79	14.22	.89	14.22
3	1	.44	14.22	.68	14.22		.74	14.22	.75	16.79
	7	.49	16.79	.80	16.79		.55	14.22	.64	16.79
	13	.35	14.22	.57	14.22		.53	14.22	.99	14.22
	19	.41	16.79	.54	16.79		.47	14.22	.51	14.22
4	1	.34	14.22	.48	14.22		.41	16.79	.47	16.79
	7	.33	12.34	.42	16.79		.43	14.22	.49	14.22
	13	.37	14.22	.48	14.22		.53	16.79	.66	14.22
	19	.40	14.22	.51	16.79		.44	14.22	.61	12.34
5	1	.32	14.22	.51	14.22		.43	14.22	.66	14.22
	7	.36	14.22	.47	14.22		.53	16.79	.68	14.22
	13	.45	14.22	.72	14.22		.68	12.34	.78	3.95
	19	.51	6.87	.63	12.34		.68	12.34	.93	3.79
6	1	.70	4.32	.86	16.79		.73	14.22	1.36	4.76
	7	.92	6.87	.87	14.22		.89	6.87	1.16	6.87
	13	.64	4.53	.76	7.42		.67	14.22	.89	6.87
	19	.76	6.40	.62	7.42		.64	14.22	.75	8.06
7	1	.43	5.99	.62	9.75		.57	16.79	.60	14.22
	7	.40	14.22	.53	14.22		.58	14.22	.59	14.22
	13	.47	14.22	.51	14.22		.54	14.22	.93	6.87
	19	.52	6.40	.71	14.22		.76	3.38	.75	6.87
8	1	.46	6.40	.62	6.87		.59	14.22	.64	6.87
	7	.36	6.40	.52	14.22		.57	14.22	.52	7.42
	13	.27	14.22	.38	12.34		.42	12.34	.59	6.87
	19	.30	14.22	.42	14.22		.45	14.22	.43	14.22
9	1	.25	14.22	.30	14.22		.33	14.22	.57	3.38
	7	**		.43	2.86		.43	12.34	.77	3.51
	13	.71	3.79	.60	3.95		.52	3.51	1.75	5.31
	19	1.15	5.99	1.22	5.99		1.22	5.99	1.62	5.99
10	1	1.03	5.99	1.22	6.40		1.21	6.87	1.29	6.40
	7	.89	5.99	1.15	6.40		1.08	6.87	.78	5.63
	13	.52	5.63	.67	5.99		.63	5.31		
	19	*					*			
11	1	.22	14.22	.39	10.89		.40	10.89	.50	7.42
	7	.19	9.75	.32	8.83		.35	12.34	.39	9.75
	13	.34	3.64	.44	9.75		.45	8.83	.60	8.83
	19	.34	9.75	.32	8.83		.36	9.75	.35	9.75
12	1	.19	9.75	.31	8.83		.31	9.75	.33	9.75
	7	.19	8.83	.33	9.75		.34	8.83	.39	8.83
	13	.23	8.83	.33	8.83		.33	8.83	.42	8.06
	19	.24	8.83	.35	8.83		.34	9.75	.41	8.83
13	1	.23	9.75	.35	8.83		.40	8.83	.41	8.83
	7	.23	9.75	.38	8.83					
	13	.34	3.79	.41	8.83		.42	9.75	.50	8.83
14	1	.49	4.53	.50	9.75		.59	9.75	.72	4.32
	7	.97	7.42	.87	8.06		.89	7.42	1.13	6.40
	13	1.47	9.75	1.64	9.75		1.79	8.83	2.03	8.83
	19	1.49	9.75	2.07	9.75		2.10	10.89	2.40	9.75
15	1	1.63	8.83	3.01	12.34		3.73	12.34	3.78	8.83
	7	1.79	12.34	2.77	9.75		3.08	12.34	3.43	9.75
	13	1.71	10.89	1.81	10.89		2.13	9.75	2.16	10.89
	19	1.32	10.89	1.26	9.75		1.53	10.89	1.67	7.42
16	1	1.21	9.75	1.12	9.75		1.25	10.89	1.40	9.75
	7	.77	9.75	.85	9.75		1.02	9.75	1.12	9.75
	13	.65	8.83	.74	9.75		.85	8.83	.99	9.75
	19	.63	8.83	.78	9.75		.83	9.75	.88	8.83

\*=Software crash

\*\*=Electronic problems

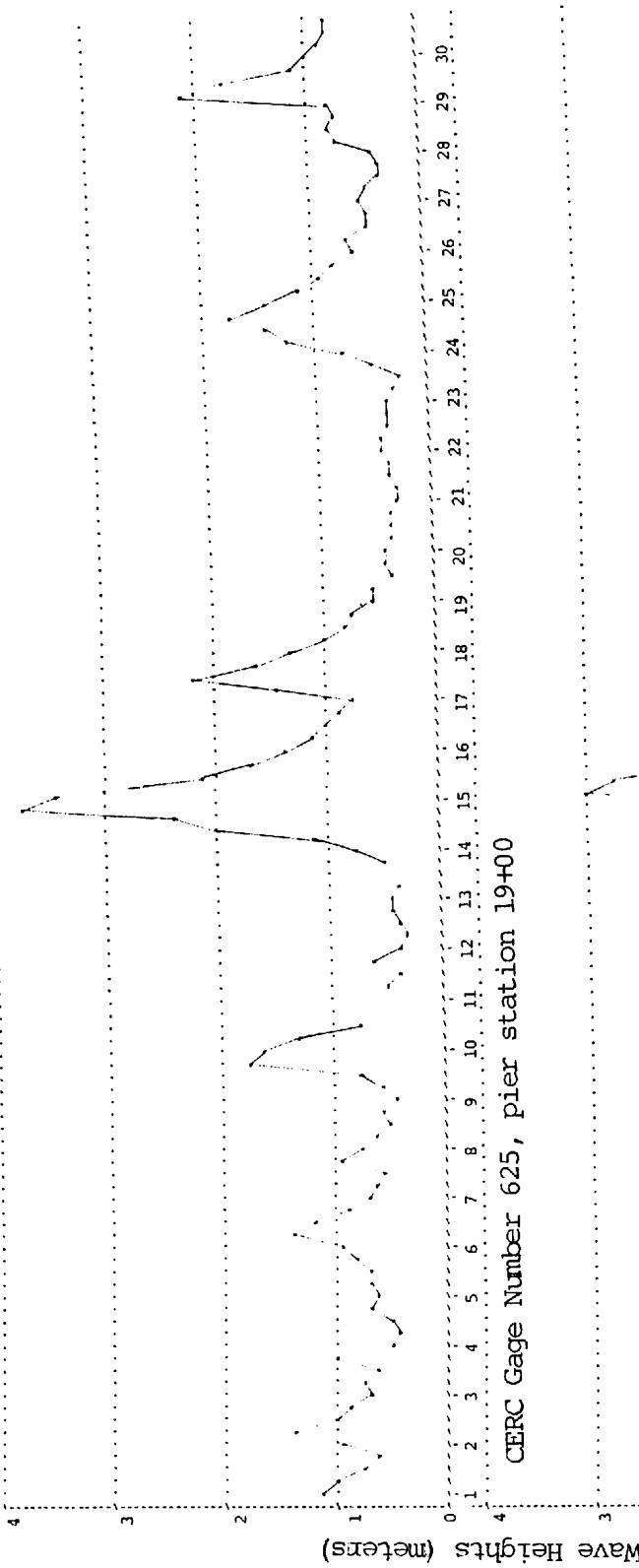
TABLE 3: WAVE DATA

PART 2

APRIL 1985

GAGE	DAY	TIME	645		625		640		630	
			Baylor at 7+80 Hmo(m)	T(sec)	Baylor at 19+00 Hmo(m)	T(sec)	Nearshr Wvrdr Hmo(m)	T(sec)	Farshr Wvrdr Hmo(m)	T(sec)
	17	1	.58	8.83	.65	8.83	.63	10.89	.74	8.83
	7		1.03	4.53	1.23	4.32	1.18	4.76	1.45	4.53
	13		1.40	6.87	1.89	5.63	1.97	6.40	2.17	6.87
	19		.89	6.40	1.29	7.42	1.45	8.06	1.65	7.42
18	1		.82	3.95	1.22	8.03	1.23	9.75	1.31	9.75
	7		.53	7.42	.92	7.42	1.00	6.87	1.01	7.42
	13		.60	5.31	.74	8.83	.79	8.06	.83	5.99
	19		.47	9.75	.62	8.06	.66	8.06	.77	8.83
19	1		.28	5.99	.43	8.83	.47	9.75	.59	8.83
	7		.30	7.42	.35	8.06	.38	10.89	.58	2.19
	13		.25	9.75	.34	9.75	.34	9.75	.40	9.75
	19		.29	8.83	.31	9.75	.32	10.89	.41	9.75
20	1		.29	9.75	.34	9.75	.34	9.75	.41	8.83
	7		.24	8.83	.26	10.89	.30	8.06	.39	9.75
	13		.21	14.22	.27	14.22	.29	9.75	.35	8.83
	19		.24	8.83	.30	8.06	.31	9.75	.38	9.75
21	1		.21	8.83	.27	8.83	.30	9.75	.34	9.75
	7		.22	8.06	.28	8.83	.30	8.06	.33	8.83
	13		.23	8.06	.29	8.06	.32	8.06	.35	7.42
	19		.30	8.83	.34	8.83	.30	8.06	.36	8.06
22	1		.30	8.06	.34	8.83	.36	8.83	.43	9.75
	7		.27	8.06	.36	8.83	.37	8.06	.42	9.75
	13		.20	8.83	.32	8.83	.35	8.06	.38	8.06
	19		.24	8.06	.30	8.83	.33	8.06	.41	8.83
23	1		.19	8.83	.31	8.83	.27	8.06	.33	8.83
	7		.18	8.06	.27	8.83	.24	8.83	.27	8.83
	13		.16	8.83	.27	8.83	.36	9.75	.49	8.06
	19		.28	8.83	.34	8.83	.62	5.02	.75	5.02
24	1		.39	4.32	.59	4.53	1.10	5.99	1.22	5.63
	7		.74	5.02	1.12	5.99	1.42	5.63	1.45	6.40
	13		.82	6.87	1.29	6.87	1.53	7.42	1.73	6.87
	19		.88	6.87	1.35	7.42	1.17	8.06	1.42	8.06
25	1		.90	6.40	1.05	6.40	.91	8.06	1.11	6.87
	7		.72	6.87	.79	6.83	.71	8.83	.91	9.75
	13		.58	6.87	.75	10.89	.74	10.89	.84	9.75
	19		.58	8.83	.66	9.75	.66	8.83	.65	10.89
26	1		.39	7.42	.59	9.75	.54	9.75	.66	9.75
	7		.37	6.40	.54	9.75	.45	9.75	.50	8.83
	13		.29	7.42	.43	9.75	.48	7.42	.53	8.06
	19		.25	8.06	.46	8.83	.40	8.06	.58	2.55
27	1		.21	14.22	.39	8.83	.30	12.34	.53	12.34
	7		.21	12.34	.36	12.34	.32	10.89	.37	10.89
	13		.18	5.02	.26	12.34	.29	10.89	.35	14.22
	19		.23	12.34	.28	12.34	.40	2.78	.46	12.34
28	1		.36	2.86	.42	2.95	.75	5.63	.76	5.63
	7		.43	3.38	.68	5.99	.69	7.42	.79	5.63
	13		.37	4.53	.73	5.63	.70	5.02	.73	5.02
	19		.50	3.26	.71	4.32	.80	6.87	.79	5.02
29	1		.64	3.26	.78	4.76	2.02	5.99	2.11	6.40
	7		1.41	5.63	2.03	5.99	1.55	6.87	1.74	6.87
	13		1.03	6.40	1.66	6.87	1.10	7.42	1.15	5.99
	19		.69	4.76	1.01	7.42	1.05	8.06	1.03	6.87
30	1		.52	5.99	.94	8.06	.81	7.42	.88	5.99
	7		.48	5.31	.83	8.06	.78	8.83	.84	8.83
	13		.40	4.53	.73	8.83	.74	8.83	.80	8.06
	19		.45	8.06	.66	8.83				
	MEAN		.54	8.44	.72	9.71	.75	9.81	.87	8.66
	STD		.36	3.38	.49	3.30	.55	3.23	.58	3.12

CERC Gage Number 630, Waverider 6 km from shore



12

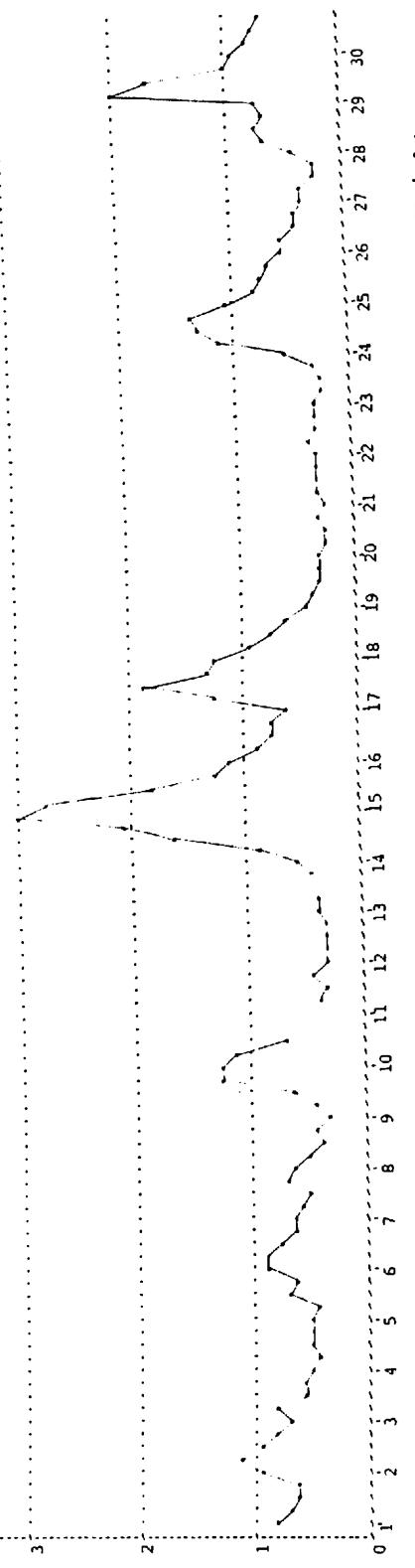
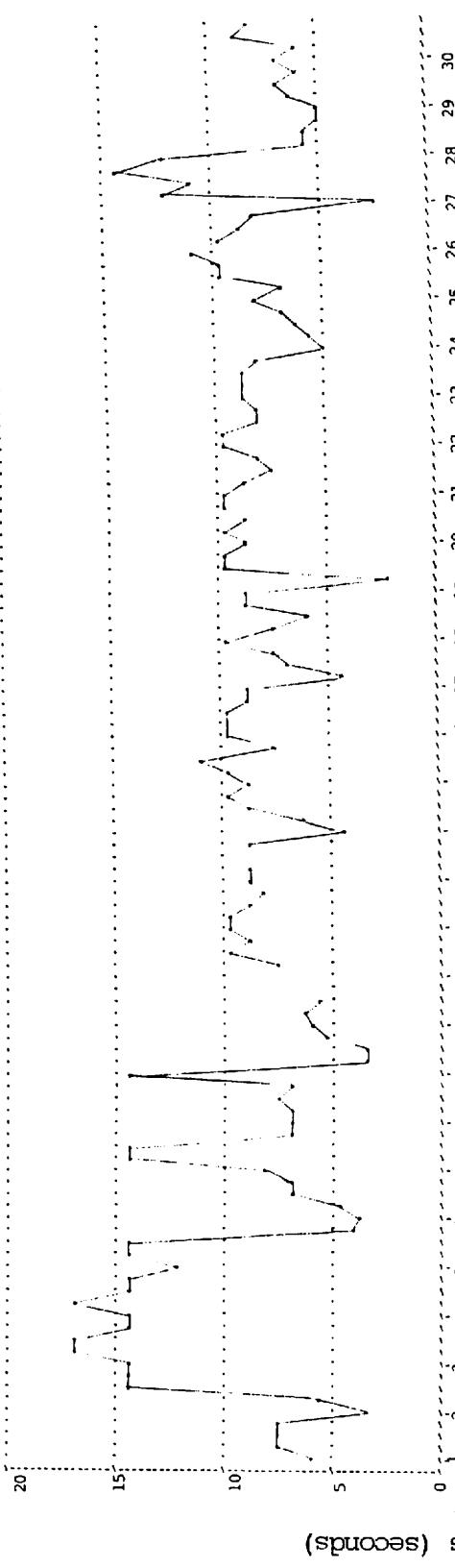


FIGURE 3. Time History of Wave Heights and Periods - April 1985  
Part I:Heights

CERC Gage Number 630, Waverider 6 km from shore



CERC Gage Number 625, pier station 19+00

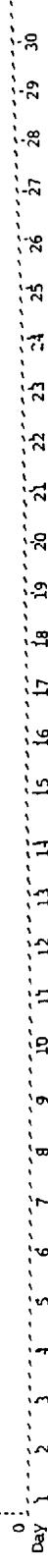
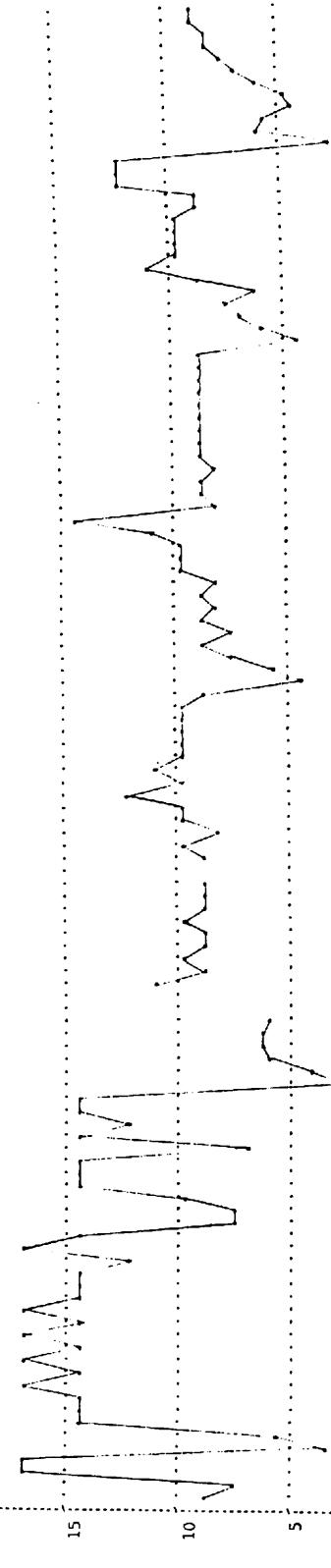


FIGURE 3. Time History of Wave Heights and Periods - April 1985  
Part II: Periods

#### IV. CURRENT DATA

Current data (Table 4) are collected from two Marsh-McBirney electromagnetic biaxial current meters (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20°W, alongshore currents flow either toward 340° (i.e. northward) or toward 160° (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: CURRENT DATA  
(SPEEDS IN CM/SEC)  
APRIL 1985

TIME	PIER MEASUREMENTS				BEACH MEASUREMENTS (500 UPDRIFT)			
	DYE AT 19+00 (579m)	CURRENT METER AT 14+20(433m)	DYE AT MID-SURF ZONE (SURFACE)	CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL)				
	SPEED DIR SPEED	DIR BASELINE(M)	SPEED DIR LOCATION	SPEED DIR SPEED				
1 0100-Alongshore	1 S				9 S			
Cross-shore	4 ON				6 ON			
Resultant	4 236				9 210			
1 0700-Alongshore	51 S	2 S	87 S		7 S			
Cross-shore	3 On	3 ON	540 0 0	South	2 OF			
Resultant	51 163	4 216	87 160		7 144			
1 1300-Alongshore		1 S			13 S			
Cross-shore		3 ON			3 OF			
Resultant		3 232			13 147			
1 1900-Alongshore		4 S			8 S			
Cross-shore		2 ON			3 ON			
Resultant		4 107			9 181			
2 0100-Alongshore		26 S			33 S			
Cross-shore		3 ON			4 OF			
Resultant		26 167			33 153			
2 0700-Alongshore	21 S	10 S	28 S		15 S			
Cross-shore	187 On	1 OF	174 8 On	North	2 OF			
Resultant	24 187	10 154	29 177		15 152			
2 1300-Alongshore		10 N			12 N			
Cross-shore		4 OF			1 OF			
Resultant		11 2			12 345			
2 1900-Alongshore		7 N			13 N			
Cross-shore		2 OF			2 OF			
Resultant		7 356			13 342			
3 0100-Alongshore		2 N			11 N			
Cross-shore		1 ON			2 OF			
Resultant		2 312			11 353			
3 0700-Alongshore	2 N	6 S	11 S		11 S			
Cross-shore	1 On	1 ON	152 10 Off	South	3 OF			
Resultant	2 313	6 121	15 118		11 146			
3 1300-Alongshore		6 N			9 N			
Cross-shore		2 OF			12 303			
Resultant		6 354						
3 1900-Alongshore		4 N			8 N			
Cross-shore		0			8 ON			
Resultant		4 340			11 296			
4 0100-Alongshore		3 N			9 N			
Cross-shore		0			6 ON			
Resultant		4 340			11 306			
4 0700-Alongshore	4 S	0	5 0		4 N			
Cross-shore	1 Off	0	139 0 0	South	2 OF			
Resultant	4 146	1 0	5 157		5 3			
4 1300-Alongshore		3 N			6 N			
Cross-shore		3 OF			2 OF			
Resultant		5 25			6 359			
4 1900-Alongshore		6 N			7 N			
Cross-shore		1 OF			4 ON			
Resultant		6 348			8 308			
5 0100-Alongshore		11 N			15 N			
Cross-shore		3 OF			2 ON			
Resultant		11 392			15 331			
5 0700-Alongshore	30 N	9 N	29 N		19 N			
Cross-shore	14 Off	1 OF	139 10 Off	South	3 ON			
Resultant	33 4	9 344	31 359		19 330			
5 1300-Alongshore		11 N			17 N			
Cross-shore		5 OF			1 ON			
Resultant		12 3			12 338			
5 1900-Alongshore		12 N			21 N			
Cross-shore		3 OF			2 ON			
Resultant		13 353			22 335			
6 0100-Alongshore		17 N			27 N			
Cross-shore		7 OF			1 OF			
Resultant		18 2			27 342			
6 0700-Alongshore	40 N	21 N	122 N		29 N			
Cross-shore	20 On	7 OF	128 12 On	South	2 ON			
Resultant	45 313	23 350	123 334		29 334			
6 1300-Alongshore		10 N			17 N			
Cross-shore		2 OF			5 ON			
Resultant		10 352			18 323			
6 1900-Alongshore		6 N			12 N			
Cross-shore		0			5 ON			
Resultant		6 340			13 312			

KEY = ALL SPEEDS IN CM/SEC  
N = NORTHWARD, SHORE PARALLEL  
S = SOUTHWARD, SHORE PARALLEL  
ON = INSHORE  
OF = OFFSHORE

TABLE 4: CURRENT DATA  
(SPEEDS IN CM/SEC.)

DAY:	TIME	PIER MEASUREMENTS			BEACH MEASUREMENTS (500 UPDRIFT)			CURRENT METER AT SOUTH TRIFOD	
		DYE AT 19+00 (579m)	CURRENT METER AT 14+20(433m) I.D.#639	DYE AT MID-SURF ZONE (SURFACE) (DEPTH -4.2m MSL)	DYE 12M OFFSHORE (SURFACE)	12M OFFSHORE (DEPTH -4.8m MSL)	I.D.#679		
		SPEED DIR SPEED	DIR BASELINE(M)	SPEED DIR	LOCATION	SPEED DIR	DIR		
7	0100-Alongshore		1 N					5 S	
	Cross-shore		0					1 ON	
	Resultant		1 340					5 177	
7	0700-Alongshore	5 0	1 S						
	Cross-shore	0 0	0	139	22 N	0 0	North	1 1	S
	Resultant	5 157	1 160		22 343			1 160	
7	1300-Alongshore		1 N					6 S	
	Cross-shore		1 OF					3 OF	
	Resultant		1 19					6 137	
7	1900-Alongshore		16 N					22 N	
	Cross-shore		4 OF					1 ON	
	Resultant		16 353					22 332	
8	0100-Alongshore		8 S					13 S	
	Cross-shore		3 ON					1 ON	
	Resultant		9 181					13 164	
8	0700-Alongshore	25 S	3 S					4 S	
	Cross-shore	11 Off	2 ON	130	8 S	4 Off	North	0	
	Resultant	28 136	4 194		9 136			4 160	
8	1300-Alongshore		4 S					10 S	
	Cross-shore		3 ON					2 ON	
	Resultant		5 192					10 171	
8	1900-Alongshore		5 S					10 S	
	Cross-shore		3 ON					2 ON	
	Resultant		6 191					10 171	
9	0100-Alongshore		15 S					24 S	
	Cross-shore		1 OF					7 OF	
	Resultant		15 156					25 144	
9	0700-Alongshore	34 S	6 S					14 S	
	Cross-shore	20 Off	4 ON	128	27 S	8 Off	North	2 0N	
	Resultant	39 129	7 194		28 143			14 160	
9	1300-Alongshore		9 S					20 S	
	Cross-shore		4 OF					2 ON	
	Resultant		10 136					20 166	
9	1900-Alongshore		15 S					22 S	
	Cross-shore		4 ON					0	
	Resultant		16 175					22 160	
10	0100-Alongshore		19 S					28 S	
	Cross-shore		8 ON					0	
	Resultant		21 183					28 160	
10	0700-Alongshore	36 S	11 S					20 S	
	Cross-shore	0 0	5 ON	152	72 S	13 Off	North	1 ON	
	Resultant	36 157	12 103		88 151			20 162	
10	1300-Alongshore		9 S					17 S	
	Cross-shore		2 ON					0	
	Resultant		10 174					17 160	
10	1900-Alongshore								
	Cross-shore								
	Resultant								
11	0100-Alongshore		12 N					15 N	
	Cross-shore		2 OF					5 ON	
	Resultant		12 349					16 322	
11	0700-Alongshore	27 N	7 N					14 N	
	Cross-shore	17 Off	0	152	29 N	15 Off	South	5 ON	
	Resultant	31 13	7 340		53 357			15 320	
11	1300-Alongshore		6 N					11 N	
	Cross-shore		0					3 ON	
	Resultant		6 340					11 325	
11	1900-Alongshore		9 N					7 N	
	Cross-shore		3 OF					0	
	Resultant		9 358					7 340	
12	0100-Alongshore		1 N					4 N	
	Cross-shore		0					0	
	Resultant		1 340					4 340	
12	0700-Alongshore	8 S	1 N					2 N	
	Cross-shore	6 On	0	152	3 S	2 Off	North	1 ON	
	Resultant	10 197	1 340		13 151			2 321	
12	1300-Alongshore		3 S					5 S	
	Cross-shore		5 OF					5 OF	
	Resultant		6 106					7 112	
12	1900-Alongshore		9 N					9 N	
	Cross-shore		2 OF					2 ON	
	Resultant		9 354					9 329	

KEY = ALL SPEEDS IN CM/SEC  
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S=SOUTHWARD, SHORE PARALLEL  
ON-ONSHORE  
OF=OFFSHORE

TABLE 4: CURRENT DATA  
(SPEEDS IN CM/SEC)

DAY:	TIME	PIER MEASUREMENTS			BEACH MEASUREMENTS			CURRENT METER AT SOUTH TRIPOD (DEPTH -4.8m MSL)
		DYE AT	CURRENT METER	DIR	DYE AT MID-SURF ZONE	DIR	12M OFFSHORE	
		19400 (579m)	AT 14420(433m) (SURFACE)	3 ON	I.D.#639 (DEPTH -4.2m MSL)	5 0	(SURFACE)	
DIR	BASELINE(M)	DIR	SPEED	DIR	LOCATION	SPEED	DIR	SPEED
25 0100-Alongshore		1	3	S				9 S
Cross-shore		1	3	ON				2 ON
Resultant		5	297					9 171
25 0700-Alongshore	5 S	1	1	S	5 0	41 N	2 N	
Cross-shore	4 Off	1	1	ON	152 0 0	North	4	ON
Resultant	6 123	2	206		5 157		5	270
25 1300-Alongshore		11	5					24 S
Cross-shore		2	OF					3 OF
Resultant		11	151					24 153
25 1900-Alongshore		1	N					0
Cross-shore		1	ON					7 ON
Resultant		1	280					7 250
26 0100-Alongshore		1	S					0
Cross-shore		1	ON					2 OF
Resultant		1	195					2 70
26 0700-Alongshore	41 S	7	5		15 S	38 S	9 S	
Cross-shore	0 0	1	ON	140	16 Off	North	1 OF	
Resultant	41 157	7	169		22 114		9	155
26 1300-Alongshore		8	S					11 S
Cross-shore		0						2 ON
Resultant		8	160					11 171
26 1900-Alongshore		3	N					2 S
Cross-shore		2	OF					6 ON
Resultant		3	6					7 231
27 0100-Alongshore		0						5 N
Cross-shore		1	ON					3 ON
Resultant		1	250					6 311
27 0700-Alongshore	11 N	2	N		47 N	2 S	7 N	
Cross-shore	17 Off	3	OF	128	12 Off	North	1 ON	
Resultant	20 36	4	32		48 354		7	320
27 1300-Alongshore		1	S					1 S
Cross-shore		0						3 OF
Resultant		1	160					3 26
27 1900-Alongshore		5 N						7 N
Cross-shore		2	OF					9 OF
Resultant		6	2					11 30
28 0100-Alongshore		1	S					2 N
Cross-shore		0						0
Resultant		1	160					2 340
28 0700-Alongshore	10 0	0		14 N		52 S	2 S	
Cross-shore	8 On	2	ON	140	11 Off	South	1 ON	
Resultant	11 197	2	250		18 17		3	182
28 1300-Alongshore		1	S					6 S
Cross-shore		1	ON					3 ON
Resultant		1	190					7 183
28 1900-Alongshore		7 S						8 S
Cross-shore		2	ON					1 ON
Resultant		7	179					8 167
29 0100-Alongshore		11 S						16 S
Cross-shore		3	ON					7 ON
Resultant		12	177					18 183
29 0700-Alongshore	61 S	40	S	122 S		91 S	41 S	
Cross-shore	15 On	6	ON	177	91 On	North	21 ON	
Resultant	63 174	41	169		152 197		46	182
29 1300-Alongshore		22	S					32 S
Cross-shore		8	ON					19 ON
Resultant		24	179					37 191
29 1900-Alongshore		7 S						12 S
Cross-shore		2	ON					7 ON
Resultant		7	176					14 190
30 0100-Alongshore		1 S						3 S
Cross-shore		2	ON					6 ON
Resultant		2	214					6 224
30 0700-Alongshore	36 S	5	S	44 S		0 0	2 N	
Cross-shore	0 0	2	OF	152	46 Off	North	6 OF	
Resultant	36 157	6	132		63 114		7 49	
30 1300-Alongshore		7 S						10 S
Cross-shore		1	ON					6 ON
Resultant		7	165					12 198
30 1900-Alongshore		1 S						3 S
Cross-shore		1	ON					1 OF
Resultant		1	214					3 132

KEY = ALL SPEEDS IN CM/SEC  
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S=SOUTHWARD, SHORE PARALLEL  
ON=ONSHORE  
OF=OFFSHORE

## V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70° east of true north; consequently, wave angles greater than 70° imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5  
SUPPLEMENTAL OBSERVATIONS  
April 1985

DAY	TIME	WAVE APPROACH ANGLE AT PIER END (° from True N)		RADAR WAVE ANGLE (° from True N)	WIDTH OF SURF ZONE (M)	WATER CHARACTERISTICS AT PIER END		
		PRIMARY	SECONDARY			TEMP (°C)	DENSITY (g/cc)	SECCI VIS (M)
1	0900	120			108	10.1	1.0246	3.4
2	0915	55			149	11.5	1.0234	2.1
3	0830	60			102	10.0	1.0239	4.0
4	0830	120			59	9.5	1.0260	3.7
5	0815	130			24	9.5	1.0264	4.3
6	0830	100		90	35	10.3	1.0260	3.0
7	1030	130			44	11.0	1.0266	4.6
8	0900	100	5		15	10.5	1.0266	3.7
9	0900	50			14	10.5	1.0253	3.7
10	0830	60		40	113	10.0	1.0250	2.4
11	0800	125			85	10.0	1.0247	3.0
12	0830	100			24	10.0	1.0242	5.5
13	0745	90			49	11.8	1.0218	4.3
14	1000	100			186	13.0	1.0214	1.8
15	1000	90		100	268	13.2	1.0232	0.9
16	0800	130			61	12.5	1.0237	1.8
17	0815	50		60	157	12.5	1.0237	0.9
18	0930	90	50		91	12.0	1.0245	1.5
19	0900	140			52	11.3	1.0238	1.8
20	0900	75			24	11.4	1.0266	3.4
21	0930	120			15	15.5	1.0218	3.0
22	0830	100			15	14.0	1.0242	2.7
23	0800	110			8	16.0	1.0238	3.4
24	0830	90		90	70	18.0	1.0207	2.1
25	0730	120			85	13.0	1.0230	1.5
26	0900	45		40	59	17.0	1.0230	2.7
27	1000	80			24	13.5	1.0254	1.8
28	0945	50	110		85	16.5	1.0238	3.0
29	0830	45		110	327	17.5	1.0230	1.2
30	0730	90	60		96	17.0	1.0218	1.5

## VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the range of each cycle while Figure 5 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

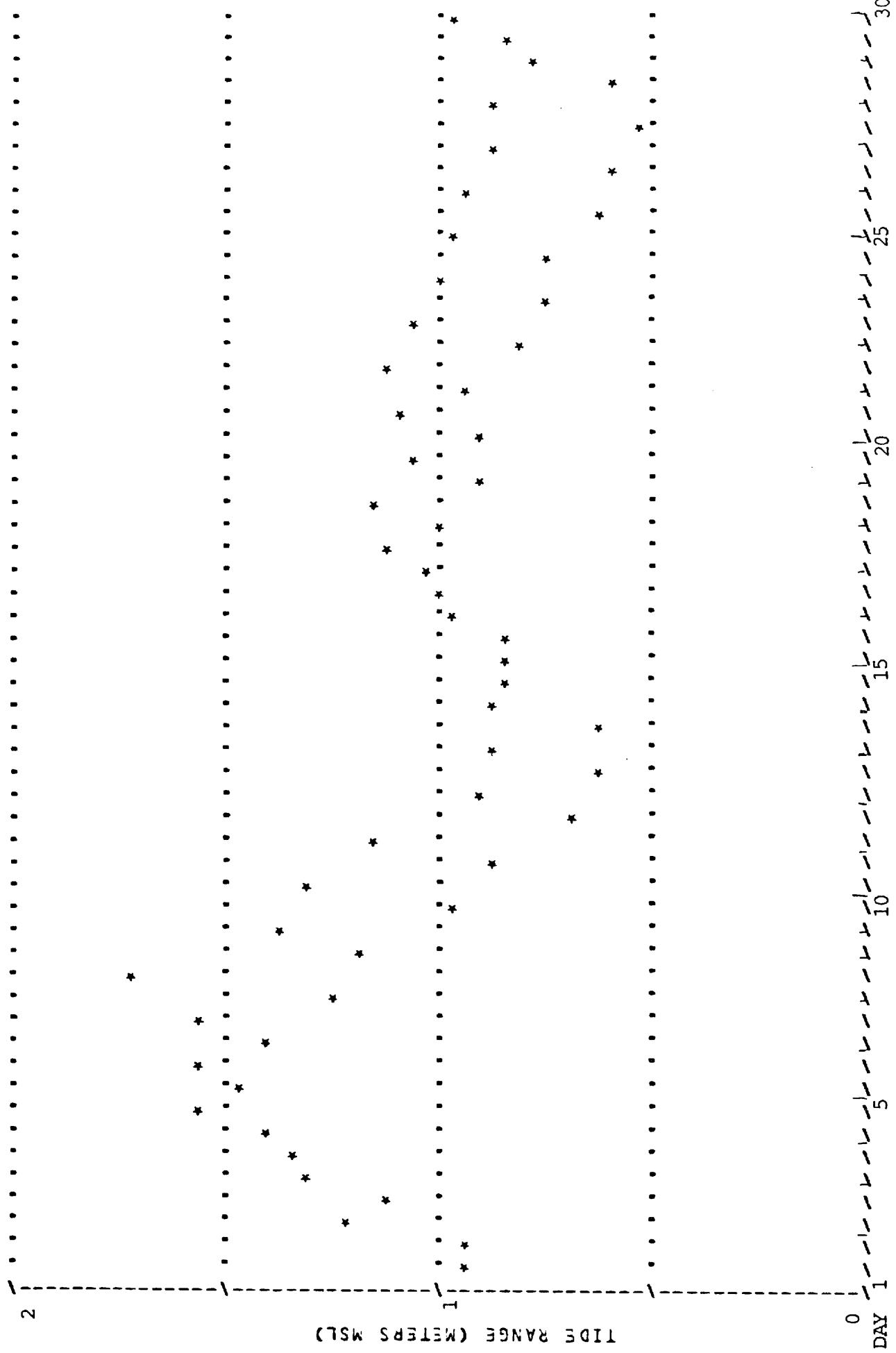


FIGURE 4. Time History of Tide Range, April 1985 (Gage No. 865-1370)

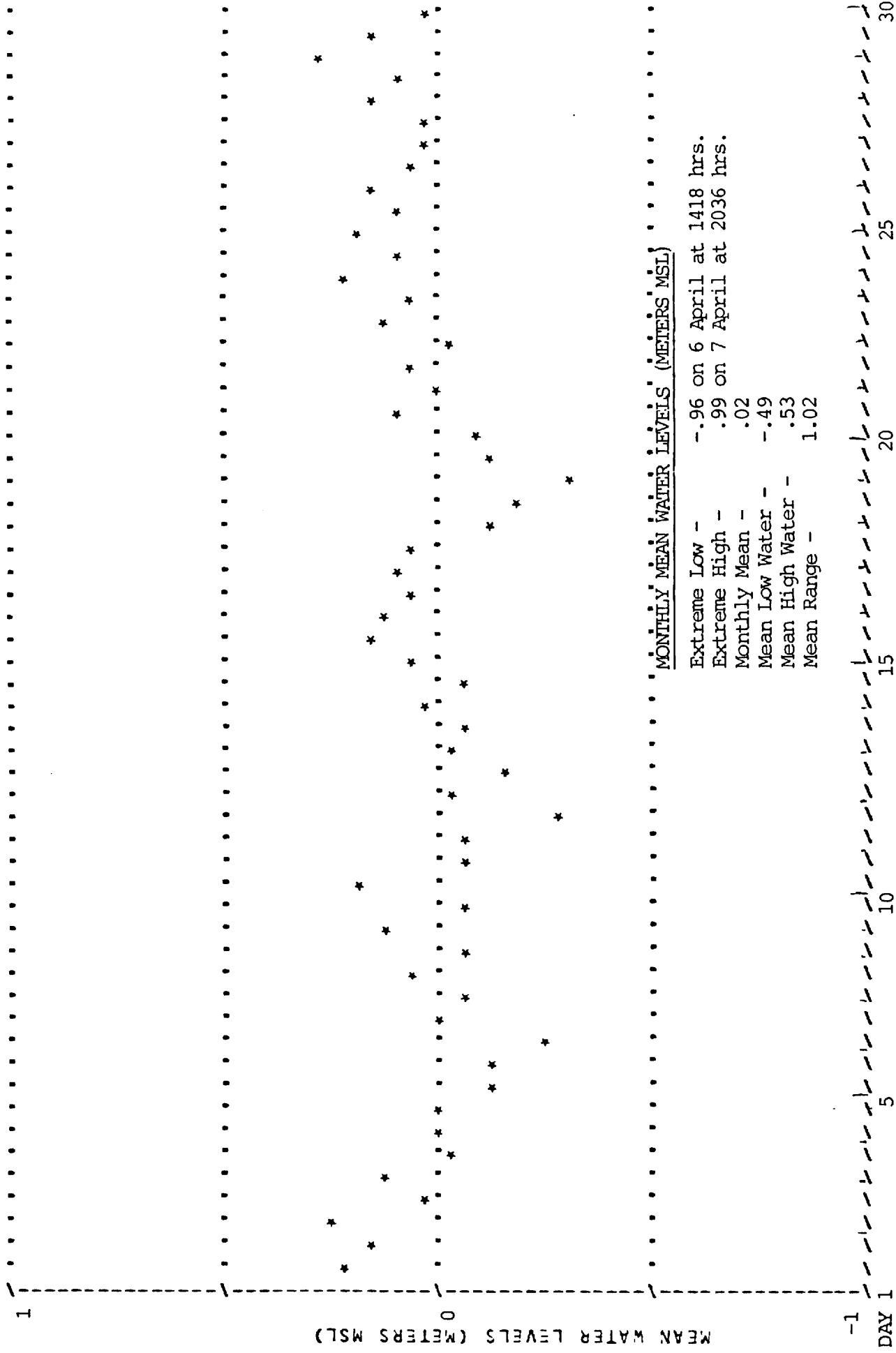


FIGURE 5. Time History of Mean Water Levels, April 1985 (Gage No. 865-1370)

MID-CYCLE DAY	TIME	LOW	HIGH	MEAN	RANGE
1	612	-.28	.66	.20	.94
1	1337	-.30	.62	.17	.93
2	702	-.36	.87	.24	1.23
2	1928	-.55	.56	.03	1.11
3	753	-.55	.77	.12	1.32
3	2018	-.71	.63	-.02	1.34
4	843	-.73	.67	-.01	1.40
4	2108	-.77	.78	.01	1.55
5	934	-.88	.57	-.14	1.45
5	2159	-.91	.65	-.13	1.56
6	1024	-.96	.44	-.26	1.40
6	2249	-.77	.78	-.01	1.55
7	1114	-.68	.57	-.06	1.25
7	2340	-.73	.99	.03	1.73
8	1205	-.68	.50	-.07	1.18
9	30	-.58	.81	.12	1.39
9	1255	-.52	.44	-.06	.96
10	120	-.43	.87	.18	1.30
10	1346	-.47	.40	-.07	.87
11	211	-.67	.50	-.06	1.17
11	1436	-.61	.08	-.28	.69
12	301	-.50	.39	-.04	.89
12	1526	-.45	.18	-.15	.63
13	352	-.50	.36	-.04	.86
13	1617	-.37	.25	-.06	.62
14	442	-.45	.44	.03	.89
14	1707	-.52	.33	-.06	.85
15	532	-.35	.49	.07	.84
15	1758	-.28	.57	.16	.85
16	623	-.36	.62	.14	.93
16	1848	-.45	.55	.07	1.01
17	713	-.40	.63	.08	1.02
17	1938	-.52	.61	.07	1.13
18	304	-.64	.37	-.13	1.01
18	2029	-.78	.38	-.18	1.17
19	854	-.74	.18	-.30	.92
19	2119	-.66	.40	-.13	1.06
20	944	-.54	.35	-.09	.89
20	2210	-.47	.63	.10	1.09
21	1035	-.48	.47	-.00	.94
21	2300	-.43	.63	.08	1.11
22	1125	-.46	.36	-.02	.82
22	2350	-.42	.65	.12	1.07
23	1216	-.34	.41	.06	.75
24	41	-.23	.75	.23	.98
24	1306	-.31	.46	.11	.77
25	131	-.27	.69	.17	.96
25	1356	-.21	.40	.10	.61
26	222	-.30	.64	.16	.93
26	1447	-.25	.34	.05	.59
27	312	-.37	.49	.04	.87
27	1537	-.26	.27	.03	.53
28	402	-.30	.56	.17	.86
28	1628	-.21	.39	.11	.60
29	453	-.11	.66	.23	.77
29	1718	-.29	.55	.15	.85
30	543	-.48	.49	.03	.97

Table 6  
WATER LEVELS (METERS MSL)  
Tidal Characteristics  
April 1985

## VII. NEARSHORE PROFILES

**A. Nearshore Profiles.** In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 6 shows the last survey in March and the two surveys taken during April on profile line 188, located 517 m south of the pier. The only changes visible during the first survey in April was a 20 m shoreward migration of the nearshore bar (160 m). The last survey in April, which followed a storm on 14-15 April, shows the re-development of both the nearshore bar (160 m) and a substantial storm bar (280-440 m).

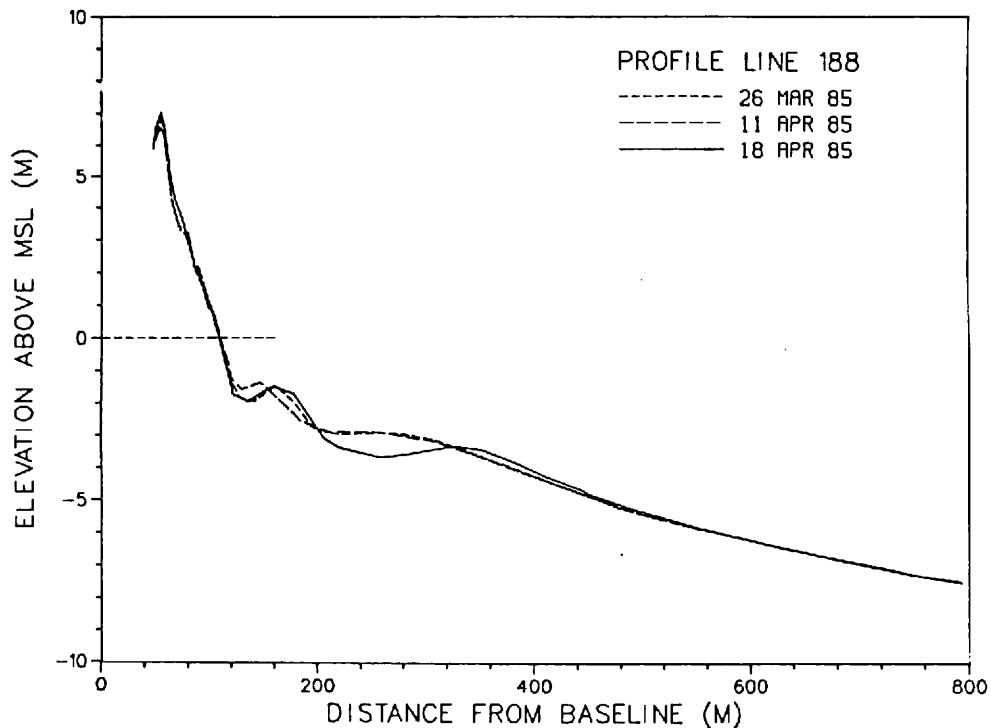


Figure 6. Monthly CRAB profiles on profile 188 -  
517 meters south of pier.

The profile envelope (Figure 7) reflects the maximum changes which occurred on the profile between January and April. Both of the significant changes visible on the envelope are a result of the development of the storm bar.

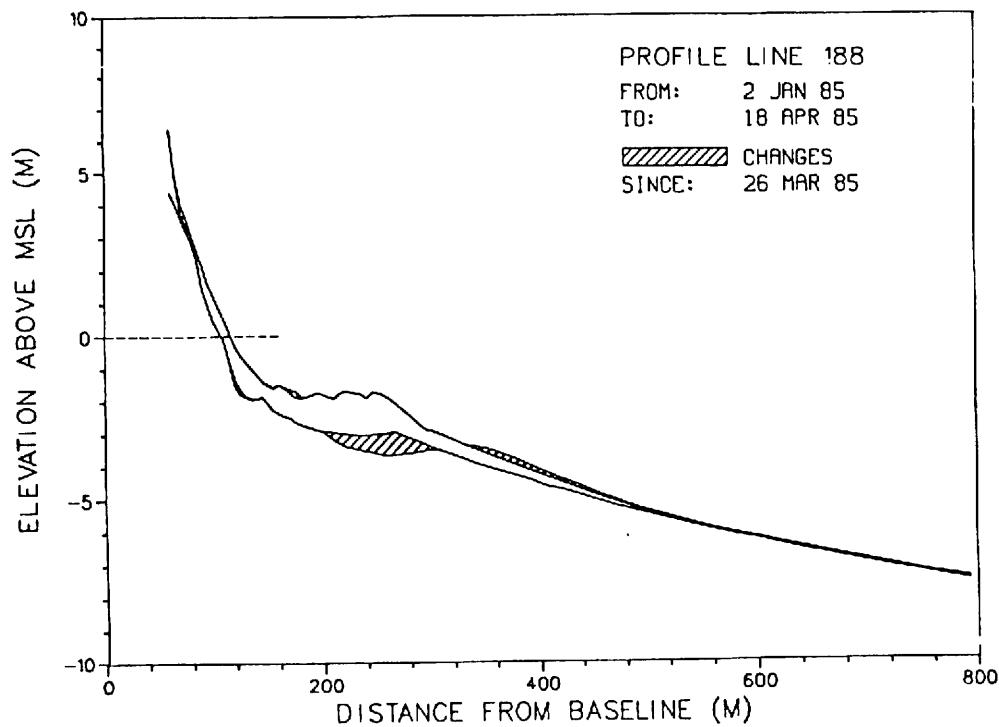


Figure 7. CRAB profile envelope - profile 188.

B. Bathymetry. The results of the bathymetric survey completed on 23 April are shown on Figure 8. The contours, especially the asymmetry of the trough to the north, reflect the predominantly southerly waves during the storm on the 14-15th and the days preceding the survey. Since the previous survey on 14 February 1985, up to 1 m of erosion from the 200 to 325 m from shore and on the beach from 100 to 150 m all along the south side and 200 m to the north appears to have been deposited along a narrow bar from 150 to 200 m. Sediment amounts up to 0.25 m were deposited 200 to 400 m north of the pier seaward of 200 m in a rip current channel. Realignment of the trough, with deposition to the south and erosion to the north from 350 to 525 m offshore, also occurred.

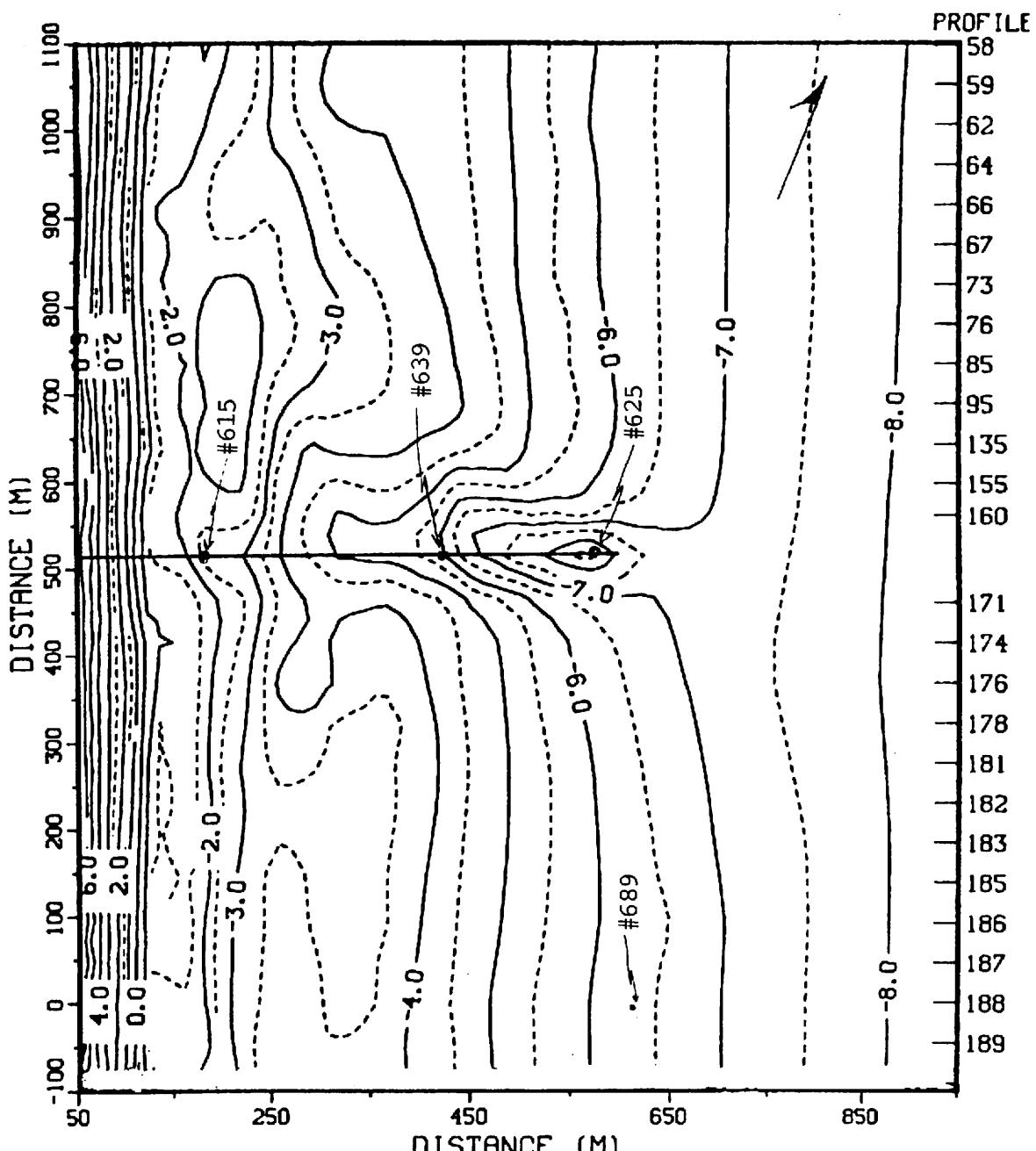


FIGURE 8. FRF BATHYMETRY 23 APR 85  
CONTOURS IN METERS

## VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor gage #625 at pier station 19+00) exceeded 2 m and wave records were obtained every hour:

<u>Start</u>	<u>End</u>
14 Apr (1900)	15 Apr (1100)

B. Storm Synopsis. On 14 April, a low pressure system formed 150 miles east of Charleston, SC, and began moving north along the coast. By 0700 on the 15th, the low was located directly over Cape Hatteras, NC and continued traveling northward throughout the day.

### Distribution List

#### Government Agencies:

OCE  
BERH  
NAO  
NASA/Wallops Flight Center  
NOAA (NOS, NWS)  
SAD  
SAW

U.S. Geological Survey  
U.S. National Park Service  
U.S. Naval Academy  
U.S. Naval Civil Eng. Lab  
U.S. Naval Facilities Eng. Com.  
U.S. Naval Research Lab

#### Colleges/Universities:

California Inst. of Tech.  
Duke University  
East Carolina University  
Florida Inst. of Tech.  
Louisiana State University  
NC State University  
Old Dominion University  
Oregon State University  
Prince George's College  
Rutgers University  
Scripps Inst. of Oceanography

Stockton State College  
Texas A&M University  
University of Akron  
University of Delaware  
University of Florida  
University of Maryland  
University of North Carolina  
University of Northern Colorado  
University of Rhode Island  
University of Virginia  
Virginia Inst. of Marine Science

#### Others:

City of Va. Beach, VA  
Coastal Barge Corporation  
Coastal and Est. Res., Inc.  
Dr. Galvin  
GEOMET, Inc.  
Greenhorne & O'Mara, Inc.  
Dr. Hylton  
Ms. Johnson  
Mary Marr, Inc.  
Masonite Corporation

Moffatt & Nichol, Eng.  
Offshore Coastal Technologies  
Research Planning Institute, Inc.  
Mr. Rowland  
Mr. Savage  
Sea Port Supply Corp.  
Shell Development  
Sohio Petroleum Co.  
Mr. & Mrs. Valpey

#### Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)